U. S. FOREST SERVICE

RESEARCH NOTE LS-27

KE STATES FOREST EXPERIMENT STATION • U. S. DEPARTMENT OF AGRICULTURE

Early Survival of Planted Trees in Southwestern Wisconsin by Species, Age Classes, and Site Factors[1]

One of the pressing forestry needs in the Driftless Area of southwestern Wisconsin, southeastern Minnesota, and adjoining counties of northeastern Iowa and northwestern Illinois is for more information on reforestation to make the currently intensified program of tree planting more effective. This area is characterized by steep topography and rich loessal soils with local intrusion of alkaline prairie soils and sometimes areas of shallow soil over bedrock.

Most of the potential planting sites are on 20- to 60-percent slopes lying between farmed land in the valleys and on the broader ridgetops. The 13-county Driftless Area in Wisconsin alone has about 303,000 acres of open but potential forest land that needs to be reforested.[2] In addition, it is estimated that some of the areas now in poorly stocked or low-value hardwood forest (approximately 1.5 million acres) require conversion to conifers or reinforcement planting to achieve better stocking. So the planting job is sizable.

With an approximate cash outlay of $50 per acre for the planting, the investment in the landowner's time and money will be quite large. The current program is still largely on land of moderate slope where mechanical tree planters accomplish about 80 percent of the total job. On the steeper, rockier lands where hand methods are necessary, costs will tend to increase. Every effort, therefore, is necessary to obtain satisfactory survival and growth once the trees are planted.

[1] *The research reported here was conducted in cooperation with the Wisconsin Conservation Department.*

[2] *Thorne, Harry W., and Stone, Robert N. Commercial forest land by forest type. U.S. Forest Serv., Lake States Forest Expt. Sta. Tech. Note 562, 2 pp, 1959.*

Studies and Treatments

To help guide forestation efforts in the Driftless Area, some experimental plantings were installed over a 2-year period (1961-1962) on the Coulee Experimental Forest near La Crosse, Wis. They involve approximately 40,000 trees. These were planted on 10 major plots with 433 subplots of 50 or 100 trees each and on 29 half-acre plots of 500 trees each. Topographic variables are north slopes, south slopes, ridgetops, and coves. The tests included five age classes; three species of broadleaf trees (white ash, red oak, and walnut), six species of pine, two of spruce, one of juniper, and one of larch; two chemical transpiration retardants; and two mechanical means of mulching and shading the soil near trees (twigs and rocks).

The standard experimental design in most of the trials involved five replications of each treatment, with treatments randomized within blocks laid out on the contour.

Ground Preparation, Planting, and Aftercare

Ground preparation for all plots planted in 1961 (Nos. 1 to 6 inclusive) was by light angle dozer with a 6-foot-wide adjustable blade which made contour terraces 12 to 16 inches wide. In 1962 ground preparation and planting was done in scalps about 1 foot square in three plots and five different methods of ground preparation on another plot.

The 1961 angle dozing did a very satisfactory job of reducing subsequent first-year weed competition on two plots. The other four plots (3, 4, 5, and 6) had hayfields with a high proportion of alfalfa or red clover or rank growth of timothy at

MAINTAINED AT ST. PAUL 1, MINNESOTA, IN COOPERATION WITH THE UNIVERSITY OF MINNESOTA

the time of ground preparation; these had to be hoed (table 1). Alfalfa 2 to 3 feet high was the worst problem, especially on plot 5 which had to be hoed several times for 2 years to keep it from smothering out the trees. No aftercare was given on plots 1, 2, 8, or 9.

Description of the Experimental Plots

The 10 experimental plots involved in the study include 7 plots on sidehills which were previously either in hayland or pasture, 2 ridgetop plots (formerly hayland), and 1 plot in a cove.

A general description of the 10 plots is given in table 1, along with first- and second-year field survival. The plots cover a range of topography, aspect, soil, and vegetation.

Nine of the ten plots are considered as having adequate moisture relations in all except extreme drought conditions. One plot is considered a droughty site of deficient soil moisture (plot 8). It is a steep, windswept, alkaline, bluestem prairie site with a pH of 7.7 in the surface foot of soil. In contrast, all the remaining sites were formerly forest land on sites less likely to induce heavy evapotranspiration, and all had a pH in the range of 5.2 to 5.7.

TABLE 1. — *Brief description of the 10 planting plots and field survival*

Plot number[1]	Year planted	Aspect	Percent of slope	Elevation in feet	Soil based on map type[2]	Relative ground competition	Compare with plot	Former land use	Percent of field survival				
									All trees		Red pine 1st yr.		
									1st yr.	2d yr.	2-0	3-0	2-1
SIDEHILL PLOTS													
2	1961	North	24	940	Gale-Hixton sa.l.	Moderate	1	Pasture	90	86	94	83	96
1	1961	South	32	940	Gale-Hixton sa.l.	do.	2	do.	86	85	96	75	90
4	1961	North	20-30	820	Fayette si.l.	do.	3	N. half hay; S. half pasture	92	90	--	--	96
3	1961	South	20-26	870	Fayette si.l. and Gale-Hixton sa.l.	do.	4	Hay	95	92	--	--	96
9	1962	North	20-32	940	Gale-Hixton l. to si.l.	do.	8	Pasture	96	--	95	96	98
8	1962	South-east	53-55	1,100	An alkaline, stony, prairie soil	Light	9	Occasional pasture	76	--	81	55	91
7	1962	South	26-28	940	Hixton sa.l.	Moderate	9	Pasture	92	--	--	90	95
RIDGETOP PLOTS													
5	1961	Mostly west	10-16	1,270	Dubuque si.l.	Very severe	3, 4, 10	Hay	85	81	--	--	82
6	1961	North	10-16	1,270	Dubuque si.l. and Fayette si.l.	Severe	3, 4, 10	do.	90	89	--	--	81
COVE PLOT													
10	1962	North	8-26	890	Colluvial l. to si.l. and some Gale-Hixton sa.l.	Severe	3, 4, 5, 6	Partly crop; partly pasture	96[3]	--	--	--	95

[1] *The convenience of the reader in comparing data determined the order in which plots are listed.*

[2] *From La Crosse County Soil Survey of 1960 by Wisconsin College of Agriculture and U.S.D.A. Sa.l. = sandy loam; l. = loam; si.l. = silt loam.*

[3] *Excludes direct seedings of walnut.*

Field Survivals and Causes of Loss or Damage

The survivals for all species and age classes combined are all quite satisfactory, ranging from 85 to 96 percent, except for the droughty plot where survival was 76 percent (table 1). The drop in survival from the first to second year on six plots ranged from 1 to 4 percent and averaged 2.5 percent. A comparison in a key species (red pine) showed that transplants usually had better survival than seedlings, and 2-0 was statistically superior to 3-0 in three of four trials.

The chief causes of mortality were drought (19.6 percent of all the trees planted on plot 8), small or spindly stock (range 0.1 to 3.0 percent), trees weakened by partial drying in transit by rail (2.6 to 5.4 percent), white grub damage (0.1 to 0.5 percent), and smothering by weeds (0.1 to 0.3 percent).

Injury to trees by animals such as deer, cottontail rabbits, and mice was negligible – usually less than 0.1 percent for any one plot. Systematic use of rodenticides and use of prescribed burns on sites with long bluegrass cover have been effective in keeping mouse populations at a low level. The most important disease was cedar-apple rust on eastern redcedar where 70.6 percent of all trees planted were infected 2 seasons after planting.

Conclusions to Date
on Preferred Species and Age Classes

A marked contrast was observed in survival of various species and age classes in the wide spectrum of sites planted. Based on these early results and supplemented by observations by the Wisconsin Conservation Department[3] regarding site adaptability of various species, a table has been compiled (table 2 on next page) showing species and age classes which have prospects of giving excellent to good initial survival on the soils and the six categories of site explored to date on the Coulee Experimental Forest.

Preferred age classes are listed first within each category. These may be expected to give 90 percent or better survival in years of approximately normal rainfall in May to August inclusive. The second choice may give about 10 percent less survival if it is seedling stock. Black walnut seeding, on the other hand, has not been very successful; to date only about 50 percent of the spots seeded have been occupied by seedlings. White pine can be planted fairly safely, providing a few precautions are observed to minimize white pine blister rust.[4]

Three of the pine species listed (Austrian, ponderosa, and Scotch) are not now distributed by Wisconsin Conservation Department nurseries. They are included in the table because they show promise of adaptability to dry, exposed, south-facing slopes with alkaline soils (known locally as "goat pastures"). The primary purpose of planting these species on such sites may be for game cover, Christmas trees, or ornamental or aesthetic values.

In summation, the table emphasizes a preference for transplants over seedlings on some sites, the possible use of seedlings on others, the exclusive need of transplants in certain species, and drought-resistant, hard pines or eastern redcedar on windswept, dry alkaline slopes.

[3] *Wisconsin Conservation Department. Tree planting in Wisconsin. Wis. Conserv. Dept. Pub. 527-59. 20 pp. 1959.*

[4] *Van Arsdel, E. P., Parmeter, J. R., and Riker, A. J. Elevation effects on temperature and rainfall correlated with blister rust distribution in southwestern Wisconsin. Phytopath. 47: 536. 1957.*

JOSEPH H. STOECKELER
Soil Scientist

October 1963

TABLE 2. — *Age classes of trees that show early promise for success on six categories of planting sites*[1]

Tree species	Hillsides			Ridgetop		Coves
	North and east slopes	South and west slopes		With dense alfalfa	With red clover or timothy	
		Former forest land	Alkaline prairie soil			
Conifer						
Larch						
European	2-1, 2-0	--	--	2-1, 1-2	2-1, 2-0	2-1, 2-0
Pine						
Austrian[2]	--	--	1-1, 2-1, 2-0[3]	--	--	--
Jack	--	--	1-1, 2-0	--	--	--
Ponderosa[2]	--	--	1-1	--	--	--
Red	2-2, 2-1, 2-0, 3-0	2-1, 2-0, 3-0	2-1[2]	2-2	2-2, 2-1	--
Scotch[2]	--	--	1-1, 2-0	--	--	--
White	2-2, 2-1, 3-0	2-1, 2-2	--	2-2	2-2, 2-1	2-2, 2-1
Redcedar						
Eastern	--	2-1, 1-1, 2-0	2-1, 1-1, 2-0	--	--	--
Spruce						
Norway	2-2	--	--	2-2	2-2	2-2
White	2-2	--	--	2-2	2-2	2-2
Broadleaf						
Ash						
White[2]	2-0	--	--	--	--	2-0
Walnut						
Black[2]	Seed	--	--	--	--	Seed
Oak						
Red[2]	1-0	1-0	--	--	--	--

[1] *Underlined age classes are suggested age classes observed elsewhere to give good survival but not actually used in the trials discussed here. If two or more age classes are given for a site condition, they are listed in order of preference.*

[2] *Still in an experimental stage, and, for conifers, only from viewpoint of Christmas trees or game cover.*

[3] *If 2-0 Austrian pine is used at all, it must be substantially better in top-root ratio and in root development than the trees used in these experiments.*